

31 percent between 1985 and 1994.⁶⁹ In general, it is estimated that the traffic control user service can reduce vehicle traveling time by seven to twelve percent.⁷⁰

a. Transit Vehicle Signal Priority

Traffic control can also be used to give roadway priority to high-occupancy transit and emergency vehicles. A DSRC-equipped transit vehicle, when identified by a DSRC-equipped intersection, can be given priority to proceed ahead of other traffic at a traffic signal.⁷¹ This function enhances the efficiency of mass transit vehicles by decreasing travel times, improving schedule adherence and enabling more predictable service. Enhanced efficiency expands the appeal of mass transit and, ultimately, helps to reduce the congestion and air pollution associated with single occupancy vehicles.

The City of Portland recently implemented transit signal priority along a major arterial in downtown Portland.⁷² Using transit signal priority at just four intersections resulted in a five to eight percent decrease in travel time on affected buses during peak traffic periods in the peak direction.⁷³ It also led to a 12.3 percent decrease in bus passenger delay on affected buses.⁷⁴

⁶⁹ Operation Time Saver pamphlet at 6.

⁷⁰ *Id.* at 5.

⁷¹ Priority can be given in two ways. First, a green light can remain green longer than normal, or a red light can turn green more quickly, to allow a bus to pass. Second, a bus stopped at a red light can receive an advance green light to proceed ahead of other traffic if there is a bus only lane or right turn only except buses lane that permits the bus to pull ahead. *See, e.g.,* Kloos, W.E. *et al.*, "Bus Priority at Traffic Signals in Portland: The Powell Boulevard Pilot Project," *Proceedings of the 1995 Annual Meeting of ITS America*, vol.1 at 499, 500 (March 1995).

⁷² *Id.* at 499-500.

⁷³ *Id.* at 501.

⁷⁴ *Id.* at 502.

b. Emergency Vehicle Signal Preemption

DSRC-equipped intersections can also identify DSRC-equipped emergency vehicles when they approach an intersection and will initiate or hold a green light until the emergency vehicles pass. In 1994, 161 people were killed in accidents involving ambulances, fire trucks, and police vehicles.⁷⁵ Emergency vehicle signal preemption can both reduce these types of accidents and improve emergency vehicle response time.

2. *Incident Management*

Incidents cause over half of the traffic congestion in the United States.⁷⁶ The term "incident" includes any event that temporarily increases demand for or reduces capacity of the roadway, like accidents, sporting events, parades and construction. Not counting the costs of air pollution and energy waste, the California Department of Transportation ("Caltrans") estimates that incident-related congestion costs \$4 million a day in the Los Angeles area alone.⁷⁷

Experience has shown that the most effective way to reduce incident-related congestion is to increase the speed with which public agencies detect and respond to unplanned incidents. For example, studies conducted on Los Angeles highways by Caltrans show that each additional minute required to clear a lane-blocking incident results in an additional four to five minutes of congestion in off-peak periods.⁷⁸ The resulting congestion is often much greater in peak periods.⁷⁹

⁷⁵ *Traffic Safety Facts 1994* at 90.

⁷⁶ Wei, C. *et al.*, "A Working Freeway Service Patrol Program: Its Role in Traffic Management," *Proceedings of the 1995 ITS America Annual Meeting*, vol. 1 at 605 (March 1995).

⁷⁷ *Id.*

⁷⁸ *National Program Plan* at 1.5.6.

⁷⁹ *Id.*

Through the use of roadway sensors and DSRC-equipped vehicles, the incident management user service reduces congestion by accelerating incident detection and response time.⁸⁰ DOT estimates that the incident management user service can reduce travel time from eight-forty percent.⁸¹

The TRANSMIT program in New Jersey has demonstrated that DSRC equipment is one of the most accurate detectors of incidents over long freeway traffic corridor areas currently available.⁸² TRANSMIT began in 1994 as an operational test along 18 miles of the New York State Thruway and Garden State Parkway. Program managers deployed transceivers from one-half mile to one and one-half mile intervals along the roadway. As transponder-equipped vehicles drive by, the transceivers record their identification number and time of arrival and transmit the information to the transit authority. The continuous, real-time flow of information allows the authority to monitor travel times and detect incidents more quickly.⁸³ The program has proven so effective that participating agencies are currently expanding its coverage to several roads east of the Tappan Zee Bridge to I-95, along several roads west of the Verrazano Narrows Bridge, and from the Outerbridge Crossing to the New Jersey Turnpike.⁸⁴

3. *En-route Driver Information*

En-route driver information provides drivers with real-time advisories about traffic conditions, accidents, construction and transit schedules. It also displays roadside sign and

⁸⁰ Public agencies report that incident clearance time decreases by up to 50 percent due to the implementation of incident management programs. *Id.*

⁸¹ Operation Time Saver at 6.

⁸² Marshall, K.R. *et al.*, "TRANSMIT: An Advanced Traffic Management System" (undated).

⁸³ *Id.* at 3-4. TRANSMIT has also proven superior to previous methods of identifying roadway bottleneck locations, identifying toll booth staffing needs and contributing to a better understanding of traffic patterns and needs. *Id.* at 4-7.

⁸⁴ *Id.* at 9-11.

roadway hazard information inside a vehicle with "in-vehicle signing." These functions allow a driver to obtain location-specific traffic information more quickly and reliably than is currently possible. In general, ITS traveler information services such as en route driver information can reduce vehicle traveling time by five to twenty percent.⁸⁵

a. In-vehicle Signing

In-vehicle signing equipment displays information from roadside transmitters on video monitors or a "heads-up" display mounted on a vehicle's dashboard or within the driver's field of vision.⁸⁶ This function is designed to present information to drivers that is pertinent to their specific circumstances based on their destination, surroundings and current activities. It permits the instantaneous transfer of both static information from roadside signs and dynamic information regarding roadway conditions. For example, in-vehicle signing can enhance driver awareness during poor weather conditions when signs are obscured from view or in potentially hazardous situations by highlighting roadside and road condition information on an in-vehicle monitor. It can also recall information, such as the current speed limit and exit locations. In addition, in-vehicle signing can alert drivers to railroad crossings, construction zones, foggy and icy conditions, fallen rocks, chemical spills, steep grades, winding curves, and many other potentially hazardous situations. Finally, the in-vehicle signing display serves as the driver interface for many other DSRC-based applications.

In-vehicle signing can help drivers avoid many common traffic accidents. As mentioned above, it can forewarn drivers of slippery road conditions and keep drivers alert, addressing the

⁸⁵ Operation Time Saver pamphlet at 6.

⁸⁶ In-vehicle signing may also present information to a driver through audio messaging. See *National Program Plan* at 1.1.5.2.

source of more than a third of all single vehicle roadway departure crashes. This function may prove especially beneficial in rural areas, the site of over half of all fatal accidents in the U.S. due to poor road conditions and high speeds.⁸⁷ Moreover, in-vehicle signing can forewarn drivers of many other common hazards, including construction and railroad crossings, and instruct them of appropriate avoidance actions. In 1994 alone, 833 people died in crashes in construction and maintenance zones⁸⁸ and nearly 5,000 highway-rail grade crossing accidents resulted in 615 deaths and 1,961 injuries.⁸⁹

b. Driver Advisory

While in-vehicle signing passes critical roadway information to the driver, the driver advisory function allows traffic managers to control the content of real-time and location-specific traffic advisory information.⁹⁰ For example, drivers can be warned of sudden backup formations such as "Speed 30 mph, 1 mile ahead!" This information details where the backup is occurring in relationship to the driver's location and allows drivers to evaluate the availability or desirability of alternate routes.⁹¹

A survey conducted in the New York metropolitan area indicates that nine out of ten drivers support building an advanced traveler information system and 78 percent are willing to

⁸⁷ *Strategic Plan* at I-4.

⁸⁸ See U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts 1994* at 90 ("*Traffic Safety Facts 1994*").

⁸⁹ Association of American Railroads, *Bulletin: Railroads Register Safest Year Ever* at 6 (undated).

⁹⁰ *National Program Plan* at 1.1.5.1.

⁹¹ *Id.* at 1.1.3 to 1.1.4.

pay for improved, real-time traffic information.⁹² Survey participants stated that the most valuable improvements would be real-time information on the location and extent of delays and traffic congestion, travel times using various routes and the arrival times of the closest mass transit vehicles.⁹³

A similar survey in Minneapolis-St. Paul found that metropolitan region drivers most strongly desired accurate and up-to-date information on accidents, construction, traffic volume and weather.⁹⁴ Specifically, participants wanted to know the precise location of bottlenecks, lanes affected, realistic delays, alternative routes with anticipated travel times, road conditions, and the length of delay.⁹⁵ DSRC equipment makes these improvements possible.

4. *Automated Roadside Safety Inspection*

Automatic roadside safety inspections use DSRC to download information from a commercial vehicle's transponder memory about the driver, the vehicle (including information regarding the status of critical systems such as the braking system and distribution of the load), the carrier and previous safety inspections, and to upload inspection results to the transponder's memory. The number of fatal accidents involving medium to heavy vehicles has fallen in recent years, from 4.1 fatal accidents for every 100 million miles driven in 1982 to 2.5 fatal accidents

⁹² Harris, P. and C.S. Konheim, "Public Interest In, and Willingness to Pay for, Enhanced Traveler Information as Provided by IVHS in the New York Metropolitan Area," *Proceedings of the 1995 Annual Meeting of ITS America*, vol. 1 at 247, 248 (March 1995).

⁹³ *Id.* at 249.

⁹⁴ Silverman, G.M. and M. Sobolewski, "ITS Market Analysis: Minnesota Guidestar's Genesis Project," *Proceedings of the 1995 Annual Meeting of ITS America*, vol.2 at 947, 951 (March, 1995).

⁹⁵ *Id.*; see also Sivanandan, R. *et al.*, "An Assessment of Rural Traveler Needs for ITS Applications," *Proceedings of the 1995 Annual Meeting of ITS America*, vol. 2 at 659, 664 (March 1995) (a nationwide survey found that the biggest concerns of rural travelers were (1) the ability to transmit a Mayday signal when a problem occurred en route; and (2) the ability to obtain en route information on road closures, congestions, approaching hazards, and to alarm drowsy drivers).

per 100 million miles in 1992.⁹⁶ Nevertheless, this number continues to be significantly higher than the average for all vehicles of 1.6 fatal accidents per 100 million miles driven.⁹⁷ Automated roadside safety inspections can help reduce the number of commercial vehicle fatalities by increasing the effectiveness of commercial vehicle safety inspections. First, states can increase the number of inspections using fewer resources because inspectors do not have to spend time looking up previous inspection histories. Second, automatic inspections allow state inspectors to keep closer track of potential hazards by, for example, monitoring the location and stability of hazardous cargo. Currently, roadside stations close the inspection lane when the queue of trucks gets too long, allowing many commercial vehicles to pass with no inspection at all. In combination with on-board safety monitoring technologies,⁹⁸ automatic roadside safety inspections can achieve significant improvements in commercial vehicle safety by permitting more frequent examinations of vehicle systems (*e.g.* brakes), cargo stability, driver requirements and driver alertness and fitness for duty.⁹⁹ Finally, automating safety inspections will save commercial trucking firms considerable time and money by reducing or eliminating both the waiting time and the duration of inspections performed at the roadside.

⁹⁶ *National Program Plan* at 5.2.2.

⁹⁷ *Id.*

⁹⁸ The on-board safety monitoring user service indicates the safety status of a driver, vehicle and cargo at mainline speeds. Sensors monitor driver alertness through devices such as "drift-and-jerk" steering sensors and optical scanning devices that monitor lateral lane position in relation to lane markings. On-board diagnostics monitor engine and vehicle systems, including tire and brake condition. Sensors also monitor cargo shifts and other unsafe conditions relating to the vehicle's cargo. If any abnormality is detected, the driver is alerted and DSRC systems can pass the information on to roadside safety inspectors.

⁹⁹ See *National Program Plan* at 5.2.3 to 5.2.4.

5. *Public Transportation Management*

The public transportation management service improves the effectiveness and efficiency of public transit systems. It has been estimated that the diversion of just one in five solo drivers to public transit would save \$30 billion per year in congestion costs.¹⁰⁰ DSRC-equipped transit vehicles can help realize these gains by improving service reliability, on-time performance, schedule information accuracy and reducing the costs of public transit. The transit management service can also reduce vehicle traveling time from 15-18 percent.¹⁰¹

For example, a public-private partnership in Minnesota has deployed a public transportation management operation along I-394 called Project Travlink. Project Travlink monitors and controls 80 public transit buses, and distributes traffic and transit information to the public via interactive "smart" kiosks in business centers, electronic signs and monitors at park-and-ride lots, and videotext terminals and personal computers in homes and offices.¹⁰² Travlink tracks the progress of individual buses with signpost detectors installed along I-394.¹⁰³ The resulting data allows dispatchers to make real-time adjustments in fleet operations, to locate buses in emergencies and to adjust bus schedules. The processed results also indicate travel speeds in the corridor, allowing the buses to double as traffic probes. Travlink then distributes the collected data in the form of real-time traveler information by notifying riders whether their bus has already

¹⁰⁰ *Id.* at 3.1.2.

¹⁰¹ Operation Time Saver at 6.

¹⁰² See Wright, J.L. *et al.*, "Minnesota Guidestar's 'Project Travlink': Some Early Lessons," *Proceedings of the 1995 Annual Meeting of ITS America*, vol. 1 at 285 (March 1995).

¹⁰³ *Id.* at 286. Travlink uses infrared signpost technology to track buses. However, this function can be performed efficiently and affordably using DSRC technology.

departed, whether it is running on-time or, if it is late, how late it is running.¹⁰⁴ Travlink is also implementing transit signal priority control for buses along the corridor.¹⁰⁵

6. *Freight Mobility*

The freight mobility user service allows dispatchers to locate and track commercial fleet vehicles, transit vehicles and their cargo, and to re-route vehicles based on real-time traffic information. This service allows fleet operators to optimize performance by enabling just-in-time pick-up and delivery, reducing driver hours sitting in congestion and waiting to deliver or receive goods, and automating cargo inventory and tracking systems.

For example, approximately 33,000 containers pass through the Sea-Land Terminal in Elizabeth, New Jersey each month.¹⁰⁶ Each of these containers may be subject to inspection by the U.S. Department of Agriculture, U.S. Customs Service, U.S. Fish and Wildlife Service, DEA, FBI, INS, and state and local police.¹⁰⁷ The approximately 6,000 trucking companies that deliver or pick up goods at the terminal are typically subject to an hour's wait simply passing through the entrance gate.¹⁰⁸ Freight mobility operations can increase the speed and efficiency with which these containers are delivered, inspected and picked-up by automating cargo identification, automating port access and automating pick-up and delivery information, vastly reducing costs for trucking companies, safety inspectors and port authorities.

¹⁰⁴ *Id.*

¹⁰⁵ *Id.*

¹⁰⁶ Easley, R. and E. Flanigan, "IVHS CVO Technology: A Positive Effect on the Ship-truck Intermodal Interface," *Proceedings of the 1995 Annual Meeting of ITS America*, vol.2 at 1081, 1083 (March 1995).

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

a. Automatic Equipment Monitoring

The automatic equipment monitoring application allows users to mount transponders on vehicles, trailers, rail cars, cargo containers, and any other items that may benefit from electronic tracking. DSRC transceivers are then installed in critical locations -- such as roadways and rail or assembly lines -- where they interrogate transponders as the equipment passes by. Transponder data can include information such as the type and temperature of the cargo, delivery schedules, and whether or not hazardous materials are present. Automatic equipment monitoring can also be used to tag stationary equipment which can then be inventoried with mobile transponders. The system automatically transfers information from the transponder to the transceiver, reducing inventory time and costs, and accelerating equipment delivery time.¹⁰⁹

By the end of 1997, the Canadian Pacific railroad will have equipped all of its rail cars with DSRC automatic equipment monitoring transponders. Transceivers will also be posted along the railways to interrogate and identify cars as they pass. Canadian Pacific uses the transponders primarily for inventory purposes as the cars pass in and out of rail yards.¹¹⁰

b. Fleet Management

Fleet management encompasses two distinct DSRC-based applications: access control and trip log. Access control uses transponders mounted on vehicles and DSRC transceivers mounted at entry portals to regulate and restrict access to freight yards, maintenance bays, parking lots and other restricted areas. The transceiver permits access only to vehicles with authorized

¹⁰⁹ "ITS Trends in Freight Management and CVO Applications" at 1068.

¹¹⁰ Hersch, W., "The Transportation Industry: A Hot-bed of Wireless Activity," *Wireless*, vol.5, no.8 at 18, 22 (September, 1996).

transponders while excluding unauthorized vehicles. Access control allows increased security at many facilities without the addition of more guards.

The trip log application downloads all DSRC events made during a trip into a log while the vehicle is stopped in a freight yard or other parking area. With this log, fleet managers can accurately determine the vehicle's route, time on the route and safety information.¹¹¹

7. Highway-Rail Intersection

This service manages highway traffic at highway-rail intersections with the use of passive (e.g., crossbuck signs) or active (e.g., flashing lights and gates) warning systems. These warning systems are triggered by DSRC equipment when a train approaches the intersection. The HRI equipment may also be connected to adjacent signalized intersections to coordinate traffic flows with highway-rail intersection activities.

C. Future DSRC-based Services

Future DSRC-based ITS services include those user services that are not yet in use but that will depend on DSRC when deployed, as envisioned in the National Architecture.

1. Intersection Collision Warning System

Infrastructure-based intersection collision warning systems, as envisioned, will use roadside speed and location sensing equipment, DSRC equipment, in-vehicle signing and trajectory computing and control electronics to help drivers avoid intersection collisions -- the most prevalent type of traffic accident in the U.S.¹¹² Intersection collision avoidance functions through application of the "three Ps" -- perceive, process and present. First, sensors perceive the

¹¹¹ *E.g., id.* at 1067.

¹¹² NHTSA, *Synthesis Report: Examination of Target Vehicular Crashes and Potential ITS Countermeasures* at 2-2. In 1991 alone, intersection collisions caused nearly 9,000 fatalities. *National Program Plan* at 7.3.2.

location, trajectory and speed of other vehicles. Next, processors calculate the likelihood of a collision and avoidance actions. Finally, information is presented to the driver in one of three forms: information on threats; instructions regarding evasive actions; or a partial system take-over of control of the vehicle.¹¹³ For example, a driver can be alerted when a high speed vehicle is approaching as she waits to cross a roadway.¹¹⁴ In addition, drivers can receive warning of an approaching vehicle about to run a red light or of the speed of on-coming vehicles when making a left turn. These and other applications will help reduce the frequency and severity of intersection collisions.

2. *Automated Highway System*

Automated highway systems (“AHS”), in their fullest envisioned implementation, will operate by transferring full control of equipped vehicles to automated systems operating on designated AHS lanes.¹¹⁵ To use the system, drivers approach the entry to the designated AHS lanes. DSRC is then used to verify that the vehicle is equipped for AHS operation (if it is not, the vehicle is routed into a non-AHS lane), the driver indicates his or her destination by voice or touchpad and the AHS assumes control of the vehicle.¹¹⁶ Once in the AHS lane, the system manages the vehicle's individual components (*e.g.* lights, throttle, brakes, steering) until the vehicle reaches the destination exit, where the system transfers control back to the driver.¹¹⁷

¹¹³ *National Program Plan* at 7.3.4.

¹¹⁴ *Id.*

¹¹⁵ *National Program Plan* at 7.7.1 to 7.7.3.

¹¹⁶ *Id.* at 7.7.4.

¹¹⁷ *Id.* at 7.7-4 to 7.7-5.

DSRC links transfer vehicle system readiness data to the roadside system during entry to an AHS highway and provide roadway status information to the AHS vehicle while on the highway. AHS systems also employ lane keeping, longitudinal collision avoidance, lateral collision avoidance, and vehicle monitoring systems. When not on the AHS lanes, these components can be used on manual roadways to warn drivers of potentially dangerous situations.

3. *Other Uses*

Other future applications, not contemplated in the National Architecture or National Program Plan, are innumerable. For example, electronic payment service transponders can be used to pay for drive-thru services like fast food restaurants, dry-cleaners, car-washes and automobile repair services. Electronic payment eliminates the need for a customer to pass money out the window or even have cash on hand. It can also increase the speed of drive-thru services and reduce personnel and administrative costs. Similarly, electronic payment services and smart cards interfaced to DSRC transponders can allow rental car companies to process rental car return payments automatically. In combination with the access control application, rental car companies can use smart cards to limit cars entering and exiting from their lot and maintain an accurate inventory of stock. DSRC technology can also be used to simplify other vehicle-based transactions, such as banking and increasing the value of a smart card.

IV. THE COMMISSION HAS ALREADY RECOGNIZED THE PUBLIC INTEREST VALUE OF ITS

The Commission has taken several steps in the last few years to help foster ITS, consistent with its mandates to "promote the safety of life and property"¹¹⁸ and to "encourage the provision

¹¹⁸ 47 U.S.C. §332(a)(1).

of new technologies and services to the public."¹¹⁹ Recent FCC activities with the most direct impact on ITS include the allocation of spectrum for location and monitoring services in PR Docket No. 93-61, the activation of wireless enhanced 911 services in CC Docket No. 94-102, the allocation of spectrum for unlicensed collision avoidance radars in ET Docket No. 94-124 and the evaluation of public safety wireless communication needs through the year 2010 in WT Docket No. 96-86. In each of these dockets, the safety and efficiency-enhancing benefits of ITS in general, and many DSRC applications in particular, have been recognized.

A. Location and Monitoring Services

In docket 93-61, the Commission authorized licensed automatic vehicle location and toll collection systems to operate in the 902-928 MHz band.¹²⁰ These services, collectively referred to as Location and Monitoring Services ("LMS"), allow users like trucking companies and municipalities to locate and track fleet vehicles, stolen cars, and even animate objects in a large geographic area with the help of spread spectrum communication devices.¹²¹ LMS also encompasses current automatic toll collection operations around the country and select other DSRC applications.

As the Commission recognized in the LMS R&O, LMS systems are an "integral" part, but not the sum total, of ITS.

¹¹⁹ *Id.* at §157(a).

¹²⁰ The Commission first licensed automatic vehicle monitoring ("AVM") on an experimental basis in 1968. *See* Further Notice of Inquiry and Notice of Proposed Rule Making, Docket No. 18302, 35 FCC 2d 692 (1972). In 1974, it authorized AVM systems to operate on a permanent basis but withheld from adopting permanent rules until the technology matured. *See* Report and Order, Docket No. 18302, 30 RR 2d 1665 (1974).

¹²¹ *See* Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems, Report and Order, PR Docket No. 93-61, FCC 95-41 at ¶ 4, 24 (released Feb. 6, 1995) ("*LMS R&O*").

ITS is a collection of advanced radio technologies that promise to improve the efficiency and safety of our nation's highways, reduce harmful automobile emissions, promote more efficient energy use, and increase national productivity. For example, it is anticipated that ITS systems will increase traffic mobility and efficiency by notifying motorists of traffic delays and recommending alternate routes, adjusting the settings of traffic signals to prevent anticipated traffic jams, and providing navigational assistance to direct a car to its destination according to the most efficient route. ITS warning systems can also be used to notify drivers of impending collisions (or even take control of the vehicle to avoid a collision), and display electronic traffic and safety signals on a car's windshield when poor weather conditions impair drivers' vision of road-side signs. It is estimated that ITS will help reduce air pollution caused by automobiles and will cut wasteful fuel consumption. Traffic congestion, which costs the United States \$100 billion annually in lost productivity, will also be minimized by innovative ITS traffic management technologies. Finally, ITS is expected to create new economic and employment opportunities. Not all of these services, however, require or rely on the use of the 902-928 MHz band.¹²²

The Commission went on to create a new subpart M in Part 90 of its rules for "Transportation Infrastructure Radio Services" ("TIRS")¹²³ of which LMS will constitute only a small part.¹²⁴

The Commission accurately foresaw in docket 93-61 that the 902-928 MHz band would not accommodate all ITS applications and that further spectrum allocations would need to be made.¹²⁵ The Commission also asserted its:

commitment to the continued integration of radio-based technologies into the nation's transportation infrastructure and ... commitment to the development and implementation of the nation's intelligent transportation systems of the future.¹²⁶

¹²² *Id.* at ¶ 5 (footnotes omitted).

¹²³ ITS America has petitioned the Commission to rename this subpart of the rules "Intelligent Transportation Systems" in order to make it more consistent with common terminology in the field. ITS America's petition for reconsideration in docket 93-61 has been supported by the Land Mobile Communications Council.

¹²⁴ *LMS R&O* at ¶6.

¹²⁵ *Id.* at ¶6, n.11.

¹²⁶ *Id.* at ¶6.

B. Wireless E911

In docket 94-102, the Commission implemented a schedule for commercial wireless voice providers to provide enhanced emergency 911 services to mobile subscribers. Enhanced 911 ("E911") services permit emergency personnel to identify automatically the phone number and location of the caller.¹²⁷ These features can improve the speed and efficiency with which emergency personnel respond to 911 calls and reduce confusion regarding location of the caller.¹²⁸ However, until the advent of vehicle location technology, it was not possible to locate automatically the position of a mobile 911 caller.

Today, as the Commission recognized, automatic vehicle location is a fully functional and increasingly exacting technology.¹²⁹ This and other ITS technologies have already marked vast improvements in motorist safety and will continue to enable even greater strides in the future.

C. Collision Avoidance Radar

In docket 94-124, the Commission opened up spectrum above 40 GHz for commercial uses, including allocating the 46.7-46.9 GHz and 76-77 GHz bands for unlicensed vehicular collision avoidance radar.¹³⁰ The Commission took this action, in part, in response to a petition from General Motors Research Corporation ("GM") which sought the use of millimeter wave technology for automotive radar systems. In its petition, GM indicated that its proposed radar

¹²⁷ See Revision of the Commission's Rules To Ensure Compatibility with Enhanced 911 Emergency Calling Systems, Report and Order and Further Notice of Proposed Rule Making, CC Docket No. 94-102, FCC 96-264 at ¶4 (released July 26, 1996).

¹²⁸ *Id.* at ¶5.

¹²⁹ *E.g., id.* at ¶¶68-72.

¹³⁰ See generally Amendment of Parts 2, 15, and 97 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications, First Report and Order and Second Notice of Proposed Rule Making, ET Docket No. 94-124, FCC 95-499 (released Dec. 15, 1995).

system would detect potential hazards in the path of a moving vehicle.¹³¹ In response, the Commission made the 46.7-46.9 GHz and 76-77 GHz bands available for exclusive use by vehicle radar systems.

D. Public Safety Communication Needs

More recently, in docket 96-86, the Commission requested comment on the implementation of rules and policies to enable the public safety community to meet its existing and evolving communication needs through the year 2010.¹³² In particular, the Commission has sought comment on the conclusions and recommendations of the Public Safety Wireless Advisory Committee ("PSWAC") -- a joint advisory committee established by the Commission and NTIA to explore the spectrum needs of public safety agencies. Among other things, the *PSWAC Final Report*¹³³ promotes the participation of non-traditional public safety organizations, such as ITS service providers, in the provision of public safety services. Moreover, the *PSWAC Final Report* and accompanying subcommittee reports stress the important public safety value of ITS and recommend expeditious allocation of the 5.850-5.925 GHz band for DSRC systems.

¹³¹ See Amendment of Parts 2 and 15 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications, Notice of Proposed Rule Making, ET Docket No. 94-124, FCC 94-273 at ¶ 5 (released Nov. 8, 1994).

At first blush, collision avoidance radar and the intersection collision avoidance user service (described *supra* at III.C.1.) appear to perform similar functions. Note, however, that the intersection collision avoidance service using a DSRC link between vehicles and roadside transmitters allows for the transmission of different types of information (*e.g.* road condition, right-of-way priority and the speed and trajectory of oncoming vehicles) over a longer distance (as communications "hop" from transmitter to transmitter) than collision avoidance radar systems, which operate over shorter, line-of-sight distances and do not transfer information.

¹³² See The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Agency Communication Requirements Through the Year 2010, Notice of Proposed Rule Making, WT Docket No. 96-86, FCC 96-155 (released April 10, 1996) ("*Public Safety NPRM*"). ITS America has filed comments in support of the *Public Safety NPRM*. See Comments of ITS America (filed Oct. 21, 1996).

¹³³ Final Report of the Public Safety Wireless Advisory Committee to the Federal Communications Commission and the National Telecommunications and Information Administration, September 11, 1996 ("*PSWAC Final Report*").

Both the *PSWAC Final Report* and the *Public Safety NPRM* correctly recognize that, in today's world, many entities in addition to traditional public safety organizations can and do perform essential public safety functions. Consequently, both documents propose a modification of public safety-related definitions to reflect and encourage this reality.¹³⁴ These modified definitions permit public safety agencies to better fulfill their missions by allowing them to utilize the full panoply of available communication and information technologies, including ITS-related services. For example, the proposed definitions would permit an independent ITS operator to provide emergency vehicle signal preemption to speed the response time of emergency personnel¹³⁵ or to install intersection collision avoidance equipment to help prevent automobile accidents¹³⁶ as a public safety service or support provider. In addition, ITS technologies can play a key role in realizing PSWAC's emphasis on improving public safety agency interoperability by, for example, gathering and disseminating real time traffic and incident information among law enforcement personnel, emergency response crews, traffic managers and others.¹³⁷

Various PSWAC subcommittees recognized these and other vital public safety-related services performed by ITS in their reports to the Commission. The Operational Requirements Subcommittee, for example, lists a host of DSRC applications that "will enhance the safety of the individual traveler" and will "enhance performance of different public safety communities' transportation and operations," including emergency vehicle signal priority, en-route driver information, incident detection and management, automated roadside safety inspection,

¹³⁴ See *PSWAC Final Report* at 45-46; *Public Safety NPRM* at ¶¶ 24, 26.

¹³⁵ This DSRC service is described *infra* at III.B.1.b.

¹³⁶ This DSRC function is described *infra* at III.C.1.

¹³⁷ See, e.g., the description of the "incident management" DSRC service *infra* at III.B.2.

intersection collision avoidance, and more.¹³⁸ The Interoperability Subcommittee cites a number of DSRC-based applications that "would benefit day-to-day..., mutual aid..., [and] task force interoperability with public safety communications systems."¹³⁹ The Spectrum Requirements Subcommittee specifically recommends allocation of the 5.850-5.925 GHz band for safety-related ITS applications.¹⁴⁰

PSWAC Steering Committee members also recognized the public safety value of ITS user services enabled by DSRC. Consequently, the *PSWAC Final Report* urges the Commission to act without delay to "finalize" the proposed allocation at 5.850-5.925 GHz for DSRC systems.¹⁴¹

Only if [this allocation and others] are undertaken promptly will Public Safety officials have access to wireless capabilities that are critical to their safety as well as their ability to effectively discharge their sworn duty to protect the life and property of our citizens.¹⁴²

V. THE PUBLIC INTEREST WILL BE SERVED BY THE ALLOCATION OF 75 MHz OF SPECTRUM TO IMPLEMENT DSRC

As recognized by Congress, the Commission, PSWAC and others, the numerous DSRC-based applications described above and a slew of other potential applications will provide immeasurable public benefits by improving safety and mobility on the nation's roadways, enhancing productivity and reducing air pollution. However, the full potential of DSRC cannot be realized within current spectrum allocations for ITS-related services.

¹³⁸ Final Report, Operational Requirements Subcommittee, Presented to Public Safety Wireless Advisory Committee at §§ 4.6.1 and 4.6.3, as submitted on July 12, 1996.

¹³⁹ Public Safety Wireless Advisory Committee Interoperability Subcommittee Final Report at 101-103, July 29, 1996.

¹⁴⁰ Final Report, Spectrum Requirements Subcommittee, Presented to Public Safety Wireless Advisory Committee at 54, 56, 58, undated.

¹⁴¹ *PSWAC Final Report* at 22.

¹⁴² *Id.* at 61.

A. An Allocation of 75 MHz Would Meet the Needs of Existing, Emerging and Future DSRC-based User Services

An allocation of 75 MHz would accommodate the robust deployment of DSRC directed by Congress in ISTEA, forecast by the National Program Plan and planned for by the ITS National Architecture. This level of spectrum support is required to attain the critical industry mass and associated economies of scale necessary to realize the many public benefits associated with the DSRC-based user services and to enable other services to emerge and evolve without the need for further regulatory action. With this allocation, ITS America believes that ITS services that use DSRC will be available at reasonable costs to the traveling public.

In the attached report "Spectrum Requirements for DSRC," ARINC demonstrates the case for an allocation of 75 MHz to fully implement DSRC for ITS purposes.¹⁴³ ARINC's conclusions are based on three fundamental tenets: (1) the need for flexibility in operation to permit frequency coordination with existing services in the band as well as between DSRC reader sites; (2) the goal of keeping in-vehicle transponders as affordable as possible (thus making the benefits of DSRC as widely available as possible); and (3) maintaining consistency with the design of many operational and experimental DSRC systems.¹⁴⁴ Building on these three factors -- flexibility, affordability, and consistency -- ARINC's report provides a case study of DSRC deployment utilizing multiple six MHz channels, a high degree of frequency reuse and a range of up to 50 meters. Specifically, ARINC demonstrates the need for eight channels of six MHz each to implement the full range of DSRC applications described above, and additional spectrum to allow for flexibility in channel assignments to coordinate frequency with other users.

¹⁴³ See ARINC, *Spectrum Requirements for Dedicated Short Range Communications (DSRC), Public Safety and Commercial Applications* (July, 1996) ("*Spectrum Requirements for DSRC*") (attached as Appendix H).

¹⁴⁴ *Id.* at 14.

ARINC employs a relatively simple calculus to determine the minimum channel bandwidth for DSRC. First, the minimum data rate required to support each DSRC application is estimated. The results demonstrate that all of the DSRC applications described above can be supported by a data rate of 600 kbps.¹⁴⁵ Next, ARINC combines this data rate with the expected transmission characteristics of DSRC systems under various proposed standards,¹⁴⁶ and concludes that 3.6 MHz of bandwidth supports transmission.¹⁴⁷ ARINC then adjusts this bandwidth to allow for multiple transmissions at different frequencies without causing interference to each other or out-of-band users.¹⁴⁸ Presupposing the use of filters, the channel bandwidth then becomes 5.616 MHz. Finally, ARINC slightly expands this bandwidth to allow for some drift of the center frequency and normal aging and degradation of components.¹⁴⁹ The result is six MHz channels.

ARINC's report also shows that eight channels are needed to implement the full set of DSRC-based user services. At least eleven ITS user services and many more individual ITS applications rely on DSRC transmission capability. Many of these applications and services are able to operate on the same channel without suffering degradation in serial transmission, reception, and processing of data. ARINC has identified such applications and grouped them together into four "installation groups:" the in-vehicle signing group; the commercial vehicle operation group; the intersection installation group; and the mobile location interrogation group.¹⁵⁰

¹⁴⁵ *Id.*

¹⁴⁶ See Section V.E. *infra* for a discussion of standards development and proposals.

¹⁴⁷ *Spectrum Requirements for DSRC* at 62.

¹⁴⁸ *Id.* at 62.

¹⁴⁹ *Id.*

¹⁵⁰ *Id.* at 17-28.

Each installation group supports several DSRC user services while operating on shared channels, reducing the overall spectrum requirement from that needed if each application were deployed separately. Other DSRC user services and applications, such as automated highway systems, transit vehicle data transfer, ETC and access control, must be deployed separately to prevent interference between operations.¹⁵¹ However, many of these applications may be able to share channels as well because the applications are typically unlikely to operate in close proximity to one another. For example, ARINC assumes that CVO installation group applications almost always occur in a different location than ETC applications, so the two can operate on the same channel even though the applications are incompatible.¹⁵² By maximizing the number of these shared channel arrangements, and implementing additional interference mitigation techniques to maximize spectrum efficiency,¹⁵³ ARINC concludes that eight channels are required to support those geographic locations that require multiple classes of DSRC functions in the same proximity.

Based on eight channels of six MHz each, 48 MHz would be required to implement DSRC if the spectrum were dedicated. However, this petition is requesting a co-primary allocation to permit sharing with the existing services authorized for the 5.850-5.925 GHz band. Government radiolocation, fixed satellite service uplinks, ISM, amateur radio operators and Part 15 devices are currently authorized to operate in the band. As explained *infra* (at section V.D.), DSRC systems are generally compatible with existing users of the band. Nevertheless, some interference to DSRC systems is possible, especially when out-of-band sources are considered. Many of these interference sources are site-specific, including fixed satellite uplinks and select government radar

¹⁵¹ *Id.* at 18.

¹⁵² *Id.* at 36.

¹⁵³ *Id.* at 37-39.

systems. Interference can be minimized by avoiding co-channel usage when within proximity of these systems.¹⁵⁴ However, some mobility in channel selection is needed to avoid non-DSRC sources of interference.¹⁵⁵

In addition, a spectrum framework for DSRC must be able to support many existing and experimental DSRC technologies. ARINC's report provides an analysis of spectrum needs employing a backscatter or modulated reflectance approach, one of the technologies currently deployed in the non-multilateration segments of the Location and Monitoring Service allocation in the 902-928 MHz band. However, as explained *infra* (at section V.E.), backscatter systems represent only one of several competing DSRC technologies. As such, ARINC's report demonstrates only one possible approach to DSRC deployment.

ITS America does not endorse a particular technical approach to DSRC deployment in this Petition. Undoubtedly, the record compiled in this proceeding will illustrate many alternative technical approaches to deployment, as well as the optimal channelization scheme associated with each. ITS America is committed to working with the Commission to examine and flexibly accommodate as many different technical approaches as possible in the spectrum allocation for DSRC in order to ensure a fully competitive DSRC marketplace. We believe that the requested 75 MHz allocation accomplishes this goal.¹⁵⁶

¹⁵⁴ *Id.* at 80.

¹⁵⁵ *Id.* at 71-82.

¹⁵⁶ Because there are competing DSRC technologies that may be deployed in the 5.850-5.925 GHz band, ITS America is not proposing at this time specific modifications to the Part 90 technical rules. ITS America believes that the record compiled in response to this Petition will speak to the specific modifications necessary to the technical rules, but notes that revision of sections 90.205, 90.207, 90.209, 90.210, and 90.213, among others, will be required.

Moreover, several standard-setting bodies are currently working toward developing air interface and other technical standards for DSRC operations. Appendix I contains specific amendments to the Commission's rules to implement DSRC operation in the 5.850-5.925 GHz band. The proposed rules are intended to permit system implementation under the various proposed standards for DSRC operation and provide the Commission with a suggested framework for implementation. Because of on-going standardization activities and the need to accommodate multiple emerging technologies, the rules do not propose specific channelization plans, licensing methods or technical rules to govern the DSRC spectrum allocation. Rather, an equitable balancing of these issues requires further consensus building within the ITS/DSRC community through continued standardization activities and otherwise. ITS America is also committed to full participation in this consensus building and to working closely with the FCC to address these issues during the Commission's deliberations on this Petition.

Finally, when considering the proper spectrum allocation for DSRC, cost is an *overriding* issue since millions of vehicles must ultimately be equipped with DSRC transponders in order to realize the enhanced capacity, safety and efficiency goals of Congress. Incremental cost savings of only a few dollars per vehicle will have a large impact on the success of the program, and program success will accrue savings in terms of tens of billions of dollars in decreased congestion, fewer vehicle accidents, increased productivity and reduced environmental costs. The simpler modulation scheme relied on by ARINC to calculate channel bandwidth helps to realize these goals.¹⁵⁷

¹⁵⁷ *Id.* at 62.

Thus, a 75 MHz allocation for DSRC meets the criteria for operational flexibility, system consistency and transponder affordability. It also satisfies the Commission's goal of spectrum efficiency. Spectrum efficiency has both a bandwidth and geographical component. Current DSRC standard proposals use bandwidths ranging from five MHz channels to paired ten MHz channels. As discussed above, ARINC's proposal examines a system utilizing multiple six MHz channels. However, the "footprint" illuminated by the antenna operating on these six MHz channels is very small. This means that frequency re-use will be very high, resulting in good overall efficiency in terms of bandwidth-area product.¹⁵⁸

Based on ARINC's report, the critical need for a robust deployment of DSRC user services, the number of services to be supported, and the various technical approaches to implementation that need to be accommodated, the Commission should allocate 75 MHz in the 5.850-5.925 GHz band to support the full implementation of DSRC for ITS purposes. This, in turn, will allow the people of the U.S. to benefit from the safety, mobility, and environmental advantages afforded by DSRC systems. It will also allow for deployment of an ITS industry at a level of cost that comports with Congress' stated intent in ISTEA.

¹⁵⁸ For example, if the following equation is used to describe spectrum efficiency:

$$\text{Efficiency} = \text{data rate} / \text{bandwidth} / \text{coverage area}$$

and a DSRC system covers a 90,000 square foot area (300 feet by 300 feet), uses a 6 MHz channel and a data rate of 600 kbits/second, then the system has an efficiency of 30.976 bits/hz/square mile.

In contrast, a cellular telephone using CDPD with a coverage area of 1 square mile, operating at 9600 bits/second on a bandwidth of 30 kHz has an efficiency of 0.32 bits/hz/square mile. The DSRC system is almost 100 times more efficient.